

# **Research Output and Citation Impact of the Indian Institute of Science, Bengaluru: A Scientometric Study**

**Dr. Lohrii Kaini Mahemei**

Assistant Librarian, Dr B R Ambedkar Central Library, Jawaharlal Nehru University,  
New Delhi, India  
[kaini12@gmail.com](mailto:kaini12@gmail.com)

## **ABSTRACT**

*The study investigates the research productivity of the Indian Institute of Science (IISc), Bengaluru indexed in the Web of Science (WoS) Core Collection database from 2017-2021. Total records of 11010 scientific research papers were analysed in terms of the year-wise distribution pattern, core journals used for publishing the research findings, authors network, collaborating countries and organizations. The study also analyses the Open Access (OA) publications by the IISc community. The result of the study indicates that the scientists are accountable for important research publications with the Average Citation per Paper (ACPP) at 73.5. The “Journal of High Energy Physics”, an open-access journal is the most preferred journal with 247 publications. The result revealed that the open-access journals received higher citations as compared to the non-open-access journals and even the ACPP is 96.2 while for the non-open-access journals the ACPP is only 2.4.*

**Keywords:** Research Output, Scientometrics, Indian Institute of Science, IISc, Open Access Publications

## **1. INTRODUCTION**

Universities and research institutions are engaged in generating new knowledge through research and scholarly publications and which play a pivotal role in enhancing the growth of an institution, individual and any discipline. The Indian Institute of Science (IISc), Bengaluru is a highly reputed institute in research and education in the academic world, both at the national and international level. The institute was established in 1909, and presently it has more than 45 departments and centres with faculties experts in their fields along with high-calibre scientists and staff.

Scientometrics tools are used to measure and assess the research productivity and developmental activities of the institutions, countries and also of the individuals engaged in scientific research. Evaluation of faculty and scientist scholarly publications, preferred journals, citation impact, and research collaborations in both national and international institutes and countries is done to study the growth and research discipline trends of the institution

where it stands in national or global scenarios. The present paper is an effort to assess the research contributions and citation impact of a prestigious institute namely: the IISc, Bengaluru. IISc was ranked 2<sup>nd</sup> in the “Overall Category” and placed at 1<sup>st</sup> position both in the “University” and “Research Institutions” of NIRF Rankings of 2022 (India Rankings 2022). IISc aim is to conduct quality research, generate new knowledge, and disseminate this knowledge through publications in high-impact journals and top conferences.

## **2. LITERATURE REVIEW**

Several studies are found to have been conducted to assess the research publications of institutions as well as universities. For the current study, some important studies are discussed as under.

Sahoo et al. (2021) examined the research productivity and citation impact of five older IISER institutions from 2015-2019. The study results revealed that the research output of basic sciences has increased. The open access (OA) scholarly papers received greater higher citations and even the ACPP were about four times higher as compared to the non-open access scholarly papers. Kumar (2018) carried out a bibliometric study of 10,491 research productivity of TIFR Mumbai published within a period from 2001-2015. The study highlighted that the most productive year was in 2015 at 9.04 per cent, and the publications of Astronomy and Astrophysics (A&A) subject were cited more than the other research filed. Pitty (2020) highlighted the research contributions of IISc during 1999-2020 and revealed the scholarly research paper of scientists. They were also focused on chronological growth, citation counts, average citations per paper, and the h-index of top IISc scientists. Siwach and Kumar (2015) analysed a total number of 1247 research productivity of Maharshi Dayanand University, Rohtak published during 2000-2013. The paper highlighted a steady increase in the number of year-wise distributions of publication of the University, the year 2001 was adjusted the highest with ACPP at 13.20. The subject category “Chemistry” tops the list with 455 research publications. Yadav et al. (2020) studied the research productivity of Mizoram University from 2004 to 2017. Results revealed that the average research output per year at 18.93. U.K. Sahoo of Mizoram University was the most prolific author, while “Current Science” was the most preferred journal for publications. Hamdiya et al. (2021) examined the research productivity of the institute of the Indian Institute of Science, Bangalore from 2000-2019 such as the year-wise distribution pattern, most productive author, and most favoured journal of the institution.

Santhakumar et al. (2020) carried out a scientometric study of 3283 research publications published by the University of Madras within a period from 2009 to 2018. The study revealed inconsistent growth in the publication, the overall average for each article was 10.89, and the h-index was 65 of the university. Pradhan and Ramesh (2017) analysed the research contributions of engineering sciences scientists at the Indian Institute of Technology Madras and Bombay from 2006-2015. Results showed that the scientists have published their publications in global journals, and IITB authors have higher citations as compared to IITM authors. Kumar and Senthilkumar (2019) conducted a scientometric study of the Indian top NIRF ranking institute research output. The results revealed that the IISc faculty scholarly research contributions are at a ratio of 28.21, the average citation per paper was 6.31 and the h-index for the period of study at 69. A. Kumar of IISc was the most productive author with an h-index of 24. To explore the research contributions of the top six Tamil Nadu universities from 2000-2017, Sadik (2018) carried out a bibliometric study. The paper's findings highlighted that scholarly publications are increasing at the average rate of

## **Research Output and Citation Impact of the Indian Institute of Science, Bengaluru: A Scientometric Study**

9.76%, CAGR for six universities at 9.76, and excellent national and international scholarly research collaboration among the university researchers. Basavaraja et al. (2019) conducted a study on the research output of faculty members of the Indian Institute of Science, Bangalore from 1989-2018 in terms of subject-wise distribution pattern, growth pattern, and international research collaboration of faculty members.

### **3. OBJECTIVES OF THE STUDY**

The present study aims to assess the following specific objectives:

- ✓ Identify the types of documents for publishing the research findings;
- ✓ Analyse the year-wise distributions with citations received from the research publications;
- ✓ Identify the IISc scientists contributions to open-access (OA) publications;
- ✓ Identify the top-most open-access journals preferred by the IISc;
- ✓ Analyse the collaborative authorship pattern, countries and organizations network based on citations received.

### **4. METHODOLOGY**

For the present study, the IISc data sets were downloaded from the Web of Science (WoS) Core Collection (Science Citation Index Expanded (SCI-EXPANDED)) bibliographic database. In the Web of Science (WoS) database search box, where affiliation was given, the “Indian Institute of Science (IISc)” data was retrieved for the required period of 5 years i.e. 2017-2021. All the scholarly publications are downloaded and analysed using MS Excel as per the objectives of the study. Network analysis was carried out using VOSviewer open-source visualization tool.

Group authored means a group of authors experimenting under international scientific research collaborations. For the current study, only the first twenty-five authors and organizations were considered in group-authored research collaborations.

### **5. DATA ANALYSIS AND DISCUSSION**

Analysis of data was carried out on the downloaded dataset using various scientometric indicators like types of documents, number of publications (TNP), the number of citations received (TNCR), authorship pattern, ranking of the journal title, etc.

#### **5.1 Document Types for Research Publishing**

**Table 1:** Document Types for Research Publishing

| <b>Document Type</b> | <b>TNP</b> | <b>%TNP</b> | <b>TNCR</b> | <b>%TNCR</b> |
|----------------------|------------|-------------|-------------|--------------|
| Article              | 9842       | 89.4        | 142949      | 89.5         |
| Review               | 427        | 3.9         | 13764       | 8.6          |
| Editorial Material   | 219        | 2.0         | 733         | 0.5          |
| Meeting Abstract     | 183        | 1.7         | 22          | 0.0          |
| Proceedings Paper    | 152        | 1.4         | 1917        | 1.2          |
| Correction           | 88         | 0.8         | 64          | 0.0          |
| Letter               | 28         | 0.3         | 67          | 0.0          |

|                       |       |       |        |       |
|-----------------------|-------|-------|--------|-------|
| Biographical-Item     | 21    | 0.2   | 4      | 0.0   |
| News Item             | 15    | 0.1   | 13     | 0.0   |
| Book Review           | 15    | 0.1   | 4      | 0.0   |
| Review; Book Chapter  | 12    | 0.1   | 185    | 0.1   |
| Article; Book Chapter | 4     | 0.0   | 12     | 0.0   |
| Retraction            | 2     | 0.0   | 0      | 0.0   |
| Article; Data Paper   | 1     | 0.0   | 13     | 0.0   |
| Reprint               | 1     | 0.0   | 3      | 0.0   |
| Total                 | 11010 | 100.0 | 159750 | 100.0 |

“TNP =Total Number of Publications; %TNP=Percentage of Total Number of Publications; TNCR =Total Number of Citations Received; %TNCR=Percentage of Total Number of Citations Received”

Table-1 reveals the types of documents preferences by the IISc scientists for publishing their research findings. Out of the 11010 contributions, “Research Articles” with 9842 publications is the highest which accounts for nearly 90% of the total contributions, followed by “Review” with 427 (3.9%) and “Editorial Material” with 219 (2%) respectively. The category “research articles” top the number of citations received with about 90% while the rest of the other categories combined received significantly fewer citations about 10% only.

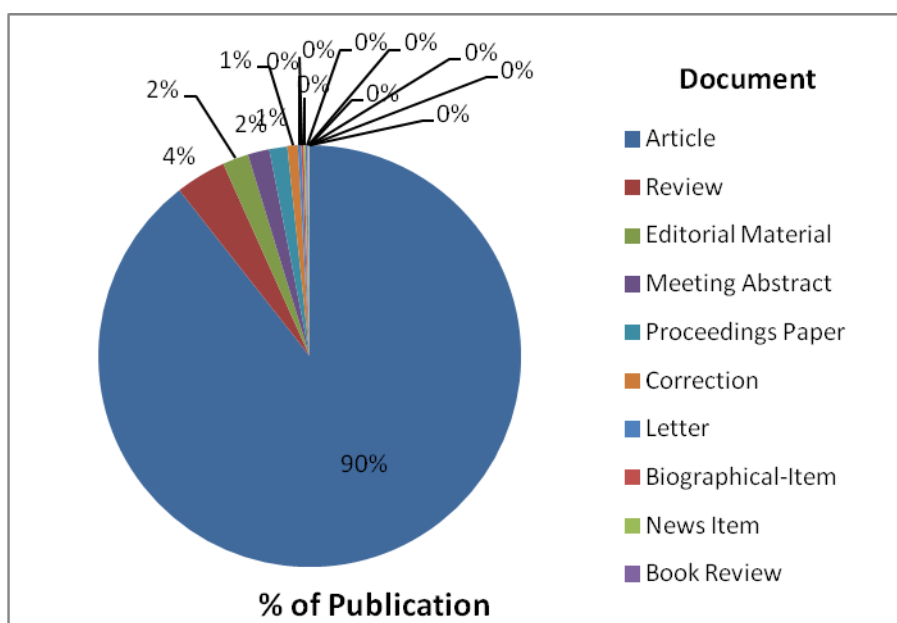


Fig. 1 Document Wise Publication Distribution

Fig.1 highlighted that the IISc research community preferred to publish in the category “research articles” with 9842 (90%) publications while the rest of the other categories combined are 1168 publications about only 10%.

### 5.2 Annual Research Output and Number of Citations Received

Table 2: Research Productivity and Citations Received

| Year | TNP  | %TNP | TNCR  | %TNCR | ACPP |
|------|------|------|-------|-------|------|
| 2017 | 2024 | 18.4 | 39631 | 24.8  | 19.6 |
| 2018 | 2211 | 20.1 | 43643 | 27.3  | 19.7 |

## Research Output and Citation Impact of the Indian Institute of Science, Bengaluru: A Scientometric Study

|       |       |       |        |       |      |
|-------|-------|-------|--------|-------|------|
| 2019  | 2178  | 19.8  | 32923  | 20.6  | 15.1 |
| 2020  | 2178  | 19.8  | 22587  | 14.1  | 10.4 |
| 2021  | 2419  | 22.0  | 20966  | 13.1  | 8.7  |
| Total | 11010 | 100.0 | 159750 | 100.0 | 73.5 |

“TNP =Total Number of Publications; TNCR =Total Number of Citations Received; ACPP=Average Citations per Paper”

Table-2 presents the distribution of research productivity by year-wise and also the citations received from these scholarly publications. The institute has contributed 11010 research articles during the period of 5 years i.e. 2017-2021. It is observed that there is a steady growth in scientific research productivity from 2024 scholarly papers in 2017 to 2419 publications in the year 2021. During the 5 years of study, the present paper revealed that a total number of 159750 citations were received. The citation for individual articles ranges from 8.7 to 19.7. It is also observed from the above table, the declining citation trend from the year 2018 (27.3%) to 2021 (13.1%). The reason for receiving higher citations may be that the older published articles get more time to collect more citations. The year 2018 received the highest number of citations with 27.3% and the ACPP also reveals the same pattern of 19.7 in the same year, followed by 19.6 and 15.1 in 2017 and 2019 respectively.

### 5.3 Top-Ranked Preferred Journals

**Table 3:** Top-Ranked Journal Titles

| R  | Journal Title                                       | TNP | TNCR | ACPP | Access Type | Publisher            | JCI  | JIF 2021 |
|----|---|-----|------|------|-------------|----------------------|------|----------|
| 1  | “Journal of High Energy Physics”                    | 247 | 4773 | 19.3 | OA          | Springer             | 1.44 | 6.376    |
| 2  | “Physical Review B”                                 | 193 | 2420 | 12.5 | H-OA        | APS                  | 0.76 | 3.908    |
| 3  | “Scientific Reports”                                | 178 | 2737 | 15.4 | OA          | Nature               | 1.05 | 4.997    |
| 4  | “Current Science”                                   | 164 | 400  | 2.4  | H-OA        | Indian Acad Sciences | 0.22 | 1.169    |
| 5  | “Physical Review D”                                 | 109 | 1960 | 18.0 | OA          | APS                  | 1.19 | 5.407    |
| 6  | “Physical Review Letters”                           | 103 | 2668 | 25.9 | OA          | APS                  | 2.33 | 9.185    |
| 7  | “European Physical Journal C”                       | 93  | 1931 | 20.8 | OA          | Springer             | 1.1  | 4.994    |
| 8  | “Physics Letters B”                                 | 92  | 8853 | 96.2 | OA          | Elsevier             | 1.49 | 4.95     |
| 9  | “Monthly Notices of the Royal Astronomical Society” | 91  | 1086 | 11.9 | OA          | Oxford Univ Press    | 1.12 | 5.235    |
| 10 | “Journal of the Indian Institute of Science”        | 74  | 225  | 3.0  | H-OA        | Springer             | 0.18 | 2.456    |

“R=Rank; TNP =Total Number of Publications; TNCR =Total Number of Citations Received; ACPP=Average Citations per Paper; JCI=Journal Citation Indicator; JIF=Journal Impact Factor”

Table-3 provides the top-ten journal titles list highly preferred by scientists for communicating their research findings. During the 5 years study period, it is found that IISc researchers published 11010 publications in 2246

various journal titles indexed in the WoS database. The “*Journal of High Energy Physics*”, an open-access journal with 247 publications having 6.376 Journal Impact Factor (JIF) is the most preferred journal for publishing the research paper, followed by “*Physical Review B*”, a hybrid open-access journal with 193 publications. During the period of study, it is revealed that out of 10 journal titles, 7 journals are open access and the other 3 journals are published with “hybrid open access”. “Springer” tops the publishers list with 962 publications, followed by the “American Chemical Society” and “IEEE-Institute of Electrical and Electronics Engineers Inc” with 881 and 706 scholarly publications respectively. The other indicators like “Journal Citation Indicator (JCI)” and “Journal Impact Factor (JIF)” displayed against each journal indicate the high value and popularity of the journal. It is observed that the Average Citations per Paper (ACPP) of top-ranked journal titles ranges from 2.4 to 96.2, where the open-access journals have high ACPP as compared to the non-open-access journals. Thus, this can be inferred that open-access journals are cited more often than non-open-access journals.

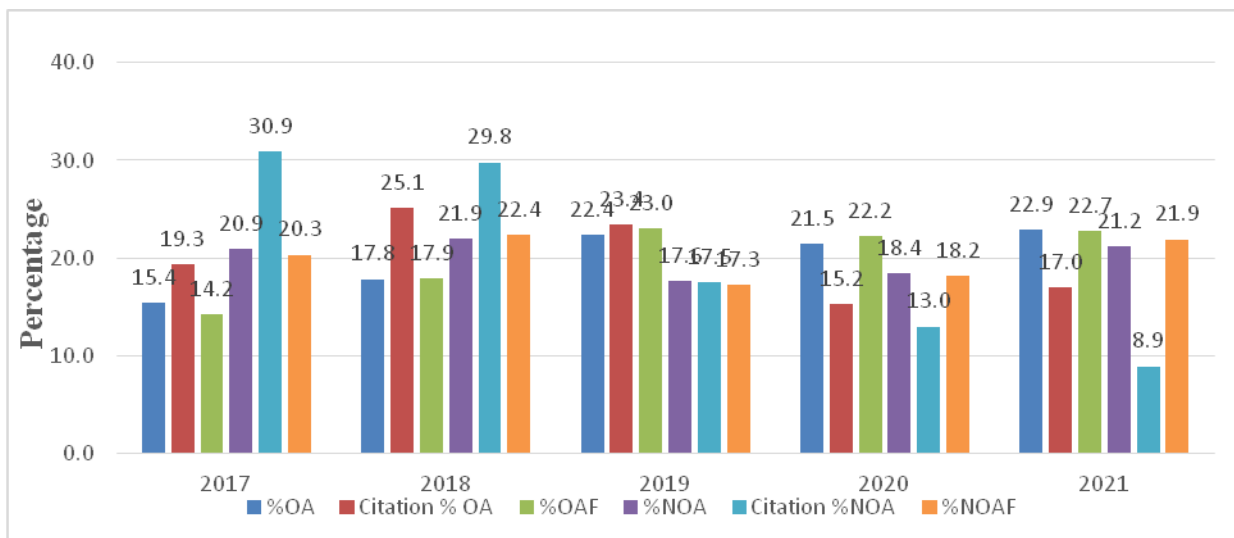
#### 5.4 Publications of Open Access, Citation and Funding Agencies

**Table 4:** Citation Count of Open Access vs Non-Open Access Publications

| Year  | OA   | %    | COA   | %    | OAF  | %    | NOA  | %    | CNOA  | %    | NOCF | %    |
|-------|------|------|-------|------|------|------|------|------|-------|------|------|------|
| 2017  | 768  | 15.4 | 16213 | 19.3 | 590  | 14.2 | 1256 | 20.9 | 23418 | 30.9 | 868  | 20.3 |
| 2018  | 890  | 17.8 | 21037 | 25.1 | 745  | 17.9 | 1321 | 21.9 | 22606 | 29.8 | 955  | 22.4 |
| 2019  | 1118 | 22.4 | 19617 | 23.4 | 958  | 23.0 | 1060 | 17.6 | 13306 | 17.5 | 737  | 17.3 |
| 2020  | 1071 | 21.5 | 12759 | 15.2 | 925  | 22.2 | 1107 | 18.4 | 9828  | 13.0 | 776  | 18.2 |
| 2021  | 1143 | 22.9 | 14233 | 17.0 | 947  | 22.7 | 1276 | 21.2 | 6733  | 8.9  | 935  | 21.9 |
| Total | 4990 |      | 83859 |      | 4165 |      | 6020 |      | 75891 |      | 4271 |      |

“OA=Open Access Publication; %=Percentage; COA=Citations Received of Open Access Publications; OAF=Open Access Publications Funded; NOA=Non-Open Access Publication; CNOA= Citations Received of Non-Open Access Publications; NOCF= Non-Open Access Publications Funded”

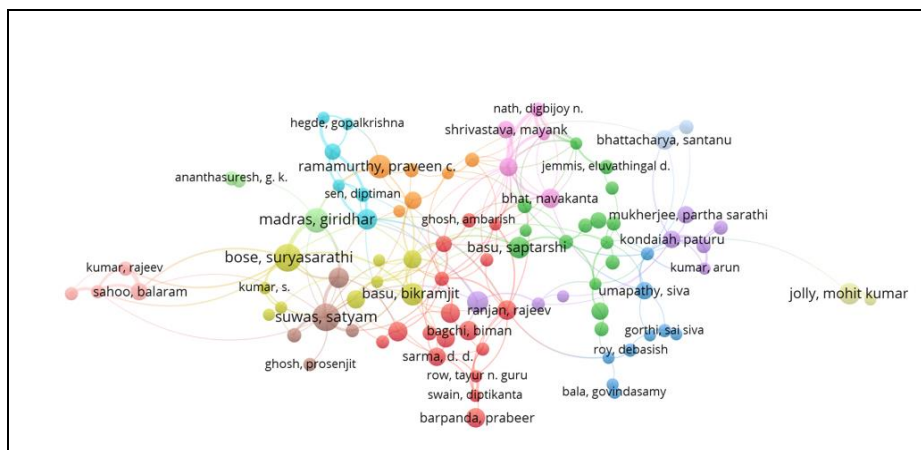
Globally the Open Access (OA) movement is developing and happening quickly as researchers worldwide can assimilate and disseminate new knowledge free of cost. Open Access publishing lower access barriers and increases the visibility of scholarly communications among the worldwide research community thereby increasing the number of citations. Lawrence, S (2001) stated the benefits of free openly available online articles which significantly increase the number of citations. Table-4 shows the citation pattern of open-access and non-open-access scholarly communications. Out of the total of 11010 scientific research papers, 4990 (45.3%) research papers are published under the Open Access (OA) category and 6020 (54.7%) under Non-Open Access (NOA) category. In the study, it is found that there is a notable growth of open-access scholarly research papers among the IISc scientists' community with 15.4% in 2017 to 22.9% in the year 2021. It is further observed that almost the same number of funding agencies both for the OA as well for non-OA publications with 4165 (49.4%) and 4271 (50.6%) respectively.



**Fig. 2** Citations % of Open Access vs Non-Open Access Publications

Fig.2 represents the difference in the number of publications and citations received between the open-access research papers and non-open-access papers. It is observed that though 54.7% are non-OA scientific papers and only 45.3% are OA publications, the open-access research contributions have received higher citations with 52.5% as compared to non-open-access articles with only 47.5%. The study also highlighted that the ACPP for open-access scientific research papers is 16.8, while the ACPP for non-open-access articles is 12.6 only. It may be mentioned here that researchers worldwide including India are moving towards open access movement to make their scholarly communications freely available online for better visibility and also for receiving higher citations and research’s impact.

### 5.5 Top-Ranked Collaborating Authors, Countries and Organizations Network



**Fig. 3** Authorship pattern network map

Fig.3 presents the most prolific authors network visualization map using the VOSviewer open-source software. Out of the total 21892 authors, 116 authors meet the set threshold i.e. the threshold value set at 25. There are some larger visual circles against the most prolific writers while few others with moderately small circles, indicating their number of research papers ranging from 25 to 125. It is observed that Bose, Suryasarathi with 125 publications is the most prolific author, followed by Suwas, Satyam with 124 research papers. Moreover, the Average Citations per Paper (ACPP) for most active authors ranges from 3.8 to 53.1.

**Table 5:** Top-Ten Collaborating Countries

| Rank | Country                    | TNP  | %TNP  | TNCR  | %TNCR | ACPP |
|------|----------------------------|------|-------|-------|-------|------|
| 1    | USA                        | 1433 | 36.4  | 26433 | 34.2  | 18.4 |
| 2    | England                    | 487  | 12.4  | 9086  | 11.7  | 18.7 |
| 3    | Germany                    | 449  | 11.4  | 8999  | 11.6  | 20.0 |
| 4    | France                     | 391  | 9.9   | 7128  | 9.2   | 18.2 |
| 5    | People's Republic of China | 259  | 6.6   | 6366  | 8.2   | 24.6 |
| 6    | Japan                      | 237  | 6.0   | 4505  | 5.8   | 19.0 |
| 7    | Australia                  | 224  | 5.7   | 5021  | 6.5   | 22.4 |
| 8    | Canada                     | 173  | 4.4   | 4088  | 5.3   | 23.6 |
| 9    | South Korea                | 154  | 3.9   | 3707  | 4.8   | 24.1 |
| 10   | Singapore                  | 133  | 3.4   | 2045  | 2.6   | 15.4 |
|      | Total                      | 3940 | 100.0 | 77378 | 100.0 |      |

During the period of study, the IISc scientists have collaborated with 111 different countries for research publications. As shown in the above table-5, the USA tops the list with 36.4% of publications and is the most prolific country for international collaborations among the IISc researchers. England and Germany are ranked in 2<sup>nd</sup> and 3<sup>rd</sup> position with 12.4% and 11.4% scientific publications. The other top-ranked collaborating countries are France, the People's Republic of China, etc with ACPP ranges from 15.4 to 24.6.

**Table 6:** Top-Ten Collaborating Organizations

| Rank | Organization  | NP   | %TNP  | NCR   | %TNCR |
|------|---|------|-------|-------|-------|
| 1    | Indian Institute of Technology (IIT)                              | 781  | 43.0  | 9734  | 38.2  |
| 2    | Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) | 201  | 11.1  | 2416  | 9.5   |
| 3    | Tata Institute of Fundamental Research (TIFR)                     | 180  | 9.9   | 2407  | 9.5   |
| 4    | National Institute of Technology (NIT)                            | 137  | 7.5   | 1725  | 6.8   |
| 5    | Indian Institutes of Science Education and Research (IISER)       | 117  | 6.4   | 1499  | 5.9   |
| 6    | Council of Scientific & Industrial Research (CSIR)                | 112  | 6.2   | 1616  | 6.3   |
| 7    | Indian Association for the Cultivation of Science                 | 106  | 5.8   | 1884  | 7.4   |
| 8    | Nanyang Technology University                                     | 64   | 3.5   | 840   | 3.3   |
| 9    | University of Cambridge   | 60   | 3.3   | 1400  | 5.5   |
| 10   | Rice University   | 57   | 3.1   | 1948  | 7.6   |
|      | Total   | 1815 | 100.0 | 25469 | 100.0 |

The research communities are reaching out to colleagues and peer in different institutions and countries worldwide to produce new scientific knowledge and published research findings. Table-6 provides the top-ten ranked list of most active organizations according to research collaborations among the IISc scientists during the period of study. It is highlighted that 4333 organizations were collaborated by authors for scholarly publications. The various "Indian



## **Research Output and Citation Impact of the Indian Institute of Science, Bengaluru: A Scientometric Study**

Institute of Technology (IITs)” tops the list with 43% publications and have also received citations of 38.2%, followed by “Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)” and “The Tata Institute of Fundamental Research (TIFR)” with 11.1% and 9.9% publications respectively. Furthermore, it is also observed that out of the top 10 ranked organizations, the top 7 organizations are from India and the rest three universities are from Singapore, England and the USA.

### **CONCLUSION**

This paper investigated the research output and the citations impact on a prestigious and reputed academic institute at the global level by applying various scientometric indicators. A total of 11010 research publications were published during the 5 years of the study i.e. 2017-2021, out of which nearly 90% of contributions are in the Research Articles category. There is a steady growth in research productivity from 2024 (18.4%) in 2017 to 2419 (22%) in 2021.

During the study period, it is observed that though the total open access (OA) research contributions are 45.3% of total research output, it received 52.5% of citations compared to the total of 54.7% non-open-access scholarly communications contributions which received only 47.5% citations. The Average Citations per Paper (ACPP) for open-access scientific research papers is 16.8, while the ACPP for non-open-access scholarly articles is 12.6 only. Thus from the study, it can be concluded that the IISc scientists who prefer to publish in OA can earn higher citations and increase their research’s impact. The total number of agencies funding the research publications both open-access publications (49.4%) and non-open-access publications (50.6%) have almost equal numbers of publications.

The “*Journal of High Energy Physics*”, an open-access journal is the most preferred journal by IISc authors for communicating their research findings, followed by “*Physical Review B*”, a hybrid open-access journal. Similarly for publishers, “Springer” tops the list, followed by the “American Chemical Society”. The ACPP for open-access journals is 96.2 which is much higher than the ACPP for non-open-access journals at 2.4. Thus, it can be inferred that open-access journals are cited more often than non-open-access journals.

Researchers are collaborating with colleagues and peer across the globe for sharing and developing new ideas and scientific knowledge. The IISc scientists have collaborated with 111 different countries for research publications, the USA (36.4%) ranked the 1<sup>st</sup> position of collaborating countries, followed by England (12.4%) and Germany (11.4%) respectively. Similarly, for organizations, the IISc authors have collaborated with 4333 organizations across the globe for scholarly publications, and the “Indian Institute of Technology (IITs)” tops the list with 43% publications, followed by “Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)” and “The Tata Institute of Fundamental Research (TIFR)” with 11.1% and 9.9% publications respectively.

This paper can help get the trends of physics research productivity of IISc and also provide analysis methods that can be applied for studying and analysing the trends of different research topics and departments of institutions or countries.

## REFERENCES

- [1] Basavaraja, M. T., Kumara, Shiva S. U., & Takappa, R. (2019). Research Productivity of Indian Institute of Science, Bangalore as Reflected in Web of Science. In Keshava, Rupesh Kumar A, & M. N. N. Prasad (Eds.), *Library in the life of the user* (pp.619-624).
- [2] Government of India. National Institutional Ranking Framework. Ministry Of Education. Retrieved May 25, 2023, from <https://www.nirfindia.org/2022/OverallRanking.html>
- [3] Hamdiya Sherin, P. P., Vasudevan, T. M., & Prasanth, M. (2021). Research Productivity of Indian Institute of Science (IISc), Bangalore During 2000-2019: A Scientometric Study. *Library Philosophy and Practice*, 2021.
- [4] Kumar, S. (2018). Bibliometric mapping of research productivity of TIFR Mumbai as seen through the mirror of Web of Science. *Library Philosophy and Practice*, 2018(May).
- [5] Kumar, S., & Senthilkumar, R. (2019). Scientometric mapping of research output of NIRF first ranked institute of India: IISc, Bangalore. *Library Philosophy and Practice*, 2019.
- [6] Lawrence, S. (2001). Free online availability substantially increases a paper's impact. *Nature*.  
<https://doi.org/10.1038/nature28042>
- [7] Pitty, N. (2020). Research Output from IISc during 1999-2020: Scientometrics Analysis Case Study. *World Journal of Advanced Engineering Technology and Sciences*, 01(02), 52–62. <https://doi.org/10.30574/wjaets>
- [8] Pradhan, B., & Ramesh, D. B. (2017). Scientometrics of Engineering Research at Indian Institutes of Technology Madras and Bombay during 2006-2015. *DESIDOC Journal of Library & Information Technology*, 37(3), 213–220.  
<https://doi.org/10.14429/djlit.37.3.10967>
- [9] Santhakumar, R., Kaliyaperumal, K., & Louies, S. (2020). Scientometric Profile of the University of Madras, The Mother of South Indian Universities. *DESIDOC Journal of Library & Information Technology*, 40(03), 185–191.  
<https://doi.org/10.14429/djlit.40.03.14844>
- [10] Sadik Batcha, M. (2019). Research output analysis of most productive universities of Tamil Nadu, India: A scientometric analysis. *Library Philosophy and Practice*, 2019.
- [11] Sahoo, J., Sahu, S. C., & Mohanty, B. (2021). Research productivity and citation impact of indian institutes of science education and research: An empirical study. *DESIDOC Journal of Library and Information Technology*, 41(6), 455–462. <https://doi.org/10.14429/djlit.41.6.17069>
- [12] Siwach, A. K., & Kumar, S. (2015). Bibliometric analysis of research publications of Maharshi Dayanand University (Rohtak) during 2000-2013. *DESIDOC Journal of Library and Information Technology*, 35(1), 17–24.  
<https://doi.org/10.14429/djlit.35.1.7789>
- [13] Yadav, S. K., Verma, M. K., & Singh, S. N. (2020). Research productivity of mizoram university during 2004-2017: A scientometric study based on indian citation index. *DESIDOC Journal of Library and Information Technology*, 40(3), 169–175. <https://doi.org/10.14429/djlit.40.3.15022>
-